

LEVEL II

②

November 1980

YW

FINAL TECHNICAL REPORT TR 80-5-315.3

Development of a  
Computerized Training Requirements and  
Cost Evaluation System for the  
U.S. Marine Corps

DTIC  
ELECTE  
DEC 08 1980  
S D E

Michael L. Donnell  
Leonard Adelman  
John F. Patterson

DECISIONS and DESIGNS, INC.

hw A092784

DDC FILE COPY

DISTRIBUTION STATEMENT A

Approved for public release;  
Distribution Unlimited

80 12 04

Prepared for  
Headquarters, U.S. Marine Corps  
under Contract MDA903-80-C-0195  
DARPA Order No. 3859

**FINAL TECHNICAL REPORT TR 80-5-315.3**

**DEVELOPMENT OF A  
COMPUTERIZED TRAINING REQUIREMENTS AND  
COST EVALUATION SYSTEM FOR THE  
U.S. MARINE CORPS**

by

*Michael L. Donnell, Leonard Adelman, and John F. Patterson*

Prepared for

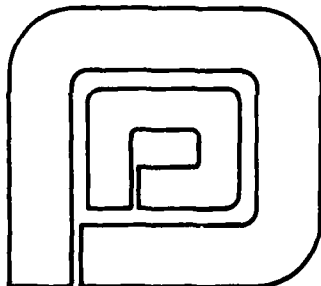
Headquarters, U.S. Marine Corps

Sponsored by

Defense Advanced Research Projects Agency  
Contract MDA903-80-C-0195  
DARPA Order No. 3859

November 1980

THE VIEWS AND CONCLUSIONS CONTAINED IN THIS DOCUMENT ARE THOSE OF THE  
AUTHOR AND SHOULD NOT BE INTERPRETED AS NECESSARILY REPRESENTING THE  
OFFICIAL POLICIES, EITHER EXPRESSED OR IMPLIED, OF THE DEFENSE ADVANCED  
RESEARCH PROJECTS AGENCY OR THE UNITED STATES GOVERNMENT.



**DECISIONS and DESIGNS, INC.**

Suite 600, 8400 Westpark Drive  
P.O. Box 907  
McLean, Virginia 22101  
(703) 821-2828

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER TR-80-5-315.3	2. JOINT ACCESSION NO. AD-A092 784	3. RECIPIENT'S CATALOG NUMBER 9
4. TITLE (and Subtitle) DEVELOPMENT OF A COMPUTERIZED TRAINING REQUIREMENTS AND COST EVALUATION SYSTEM FOR THE U.S. MARINE CORPS.	5. TYPE OF REPORT & PERIOD COVERED Final Technical Report,	
7. AUTHOR(s) Michael L. Donnell Leonard/Adelman John F. Patterson	6. PERFORMING ORG. REPORT NUMBER	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Decisions and Designs, Inc. Suite 600, 8400 Westpark Drive, P.O. Box 907 McLean, VA 22101	8. CONTRACT OR GRANT NUMBER(s) MDA903-80-C-0195,	
11. CONTROLLING OFFICE NAME AND ADDRESS Defense Advanced Research Projects Agency Cybernetics Technology Division, Decision Sciences Office, 1400 Wilson Blvd., Arlington, VA 22209	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS DARPA Order 3859	
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	12. REPORT DATE November 1980	
	13. NUMBER OF PAGES 73	
	15. SECURITY CLASS. (of this report) UNCLASSIFIED	
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE	
16. DISTRIBUTION STATEMENT (of this Report)  Approved for public release; distribution unlimited		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES This report was preceded by Semi-Annual Report PR 80-10-315, AD A085660. It is supplemented by <u>Users Guide to Accompany the Computerized Training Requirements and Cost Evaluation System for the U.S. Marine Corps</u> (UG 80-2-315.3).		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Cost effectiveness                      Marine Corps training Cost-benefit analysis                  Resource allocation Combat readiness                        MCCRES Resource management		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This final report describes efforts to develop a resource management system for U.S. Marine Corps (USMC) combat units to improve the level of combat readiness. Specifically, this report delineates the conceptual framework, technical characteristics, and operational capabilities of the prototype benefit-cost model and accompanying computer software (called CTRACES) being developed for the Marine Corps Training Requirements and Cost Evaluation System (TRACES).		

DD FORM 1 JAN 73 1473

EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

The general level of combat readiness throughout the Armed Forces depends on the allocation of DoD resources. The ideal way to handle this classic resource management problem is to allocate the resources necessary to correct any discrepancies between the current level of combat readiness on one hand, and U.S. national security goals and command missions on the other. The objective of this prototype system is to assist battalion commanders in developing cost-effective strategies for allocating funds for remedial training based upon their unit's Marine Corps Combat Readiness Evaluation System (MCCRES) scores.

Resource management systems have two broad components: an evaluation system and an allocation system. In 1976-1977, the Defense Advanced Research Projects Agency (DARPA) funded the development of a prototype evaluation methodology for MCCRES which was adopted by the USMC in 1977 as their standard combat readiness assessment method. DARPA also funded the development of CTRACES, which is the allocation component of the resources management system. With CTRACES, battalion commanders will be able to identify how many points and what percentage of the MCCRES deficit their battalion can be expected to make up for the best package of remedial training options at a specific dollar level of cost. In addition, battalion commanders will be able to evaluate the expected benefit and cost of particular training packages that they, or others, have proposed for consideration. Field testing, expected for the fall of 1980, is necessary to modify and improve the system.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

## EXECUTIVE SUMMARY

This final report describes the conceptual framework, technical characteristics, and operational capabilities of the prototype benefit/cost model and accompanying computer software developed by Decisions and Designs, Inc. (DDI) for the Marine Corps Training Requirements and Cost Evaluation System (TRACES). The computerized system will be called CTRACES, for Computerized Training Requirements and Cost Evaluation System. Its objective is to assist battalion commanders in developing cost-effective strategies for allocating funds for remedial training based upon their unit's Marine Corps Combat Readiness Evaluation System (MCCRES) scores.

To accomplish its objective, CTRACES will be capable of providing a battalion commander with the following information: (1) those areas in which the battalion exhibited performance deficits in the course of its MCCRES evaluation; (2) the different training options (or activities) that can be exercised to improve performance on individual tasks within each Mission Performance Standard (MPS); (3) the projected remedial training benefit of each option for tasks within each MPS; (4) the projected cost of each training option; (5) the projected improvement in combat readiness that can be expected for specific expenditures of training funds; (6) the expected cost required to improve the battalion's combat readiness by a specific amount; and (7) better (more improvement for the same cost) and cheaper (less cost for the same improvement) alternatives to a specified training package.

## CONTENTS

	<u>Page</u>
EXECUTIVE SUMMARY	ii
FIGURES	iii
1.0 INTRODUCTION	1
2.0 TECHNICAL APPROACH	5
2.1 Conceptual Framework	5
2.2 Technical Characteristics	10
2.2.1 Inputs to TRACES/CTRACES	11
2.2.1.1 Information of MCCRES MPS's and Tasks	11
2.2.1.2 Information on remedial training options	12
2.2.1.3 The values of the remedial training options	12
2.2.2 Data manipulation by CTRACES	17
2.2.3 CTRACES outputs	20
2.2.3.1 Outputs concerning points to make up	20
2.2.3.2 Outputs concerning Pareto Packages and Major Options	21
2.2.3.3 Outputs concerning Specified Packages	22
3.0 SUMMARY	31
APPENDIX A	A-1
APPENDIX B	B-1

## FIGURES

<u>Figure</u>		<u>Page</u>
1-1	DoD MANAGEMENT OF COMBAT READINESS	2
1-2	COMMAND MANAGEMENT OF COMBAT READINESS	2
2-1	SCHEMATIC MAUA MODEL OF MCCRES FOR INFANTRY UNITS	6
2-2	SCHEMATIC REPRESENTATION OF THE BENEFIT MODEL WITHIN CTRACES	9
2-3	APPROPRIATENESS OF DIFFERENT TRAINING OPTIONS FOR DIFFERENT TASKS	14
2-4	PERCENTAGE - DEFICIT - MADE UP FOR MPS 2B.4: ATTACK	16
2-5	TRACES OUTPUTS CONCERNING DEFICITS SORTED BY MPS AND TASK	21
2-6	POINTS ON THE PARETO PLOTTED BY PMU AND COST	24
2-7	LISTING OF POINTS ON THE PARETO	25
2-8	PLOT OF LECTURES AND MAJOR OPTIONS GIVING COST, PMU, AND #ENH	26
2-9	LIST OF LECTURES AND MAJOR OPTIONS GIVING COST, PMU, AND #ENH	27
2-10	PLOT OF SELECTED PACKAGE, CHEAPER PACKAGE, AND BETTER PACKAGE	28
2-11	POINTS MADE UP BY TASK FOR SPECIFIED PACKAGE	29

## 1.0 INTRODUCTION

Combat readiness is the primary goal of the Department of Defense (DoD). In the final analysis, virtually all of the resources of DoD are, or should be, dedicated to providing and maintaining combat-ready ground, sea, and air forces for the maintenance of U.S. national security. Implicit in that goal is the presumption that combat readiness is directly related to deterrence and to the likely effectiveness of armed forces, should they become engaged in actual combat. In this context, combat readiness is that organizational quality which reflects the level of preparedness for future combat.

The general level of combat readiness throughout the Armed Forces depends on the allocation of DoD resources. Changes in the allocation of defense resources undoubtedly cause corresponding changes in the level of combat readiness. That relationship suggests that the pursuit of combat readiness is a classic problem in resource management, one that is explained in the following paragraphs.

Ideally, as depicted in Figure 1-1, DoD resource managers would regularly sample and compare the current level of combat readiness with existing U.S. national security goals. The direction and extent of the deviation of the state of readiness from those goals would then stimulate the allocation of those particular DoD resources necessary to correct the discrepancy.

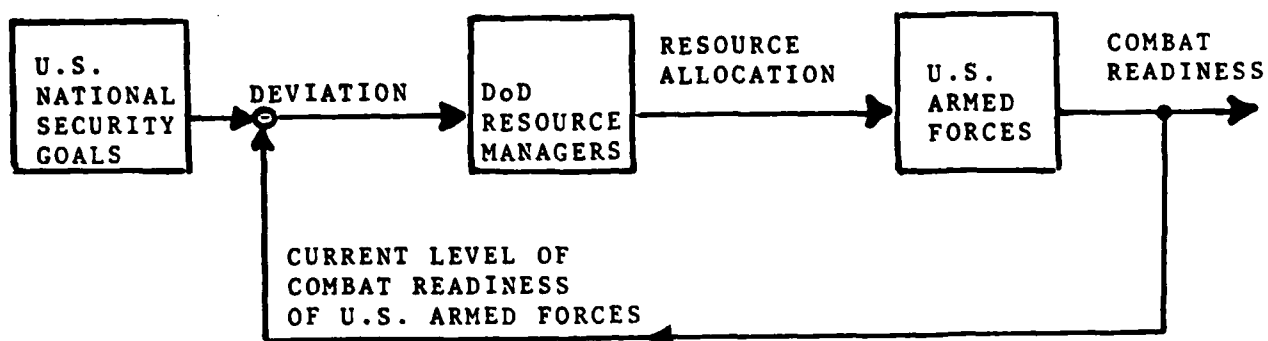


Figure 1-1

#### DoD MANAGEMENT OF COMBAT READINESS

The same feedback and control logic also applies to the management of force combat readiness by the appropriate headquarters command and to the management of unit combat readiness by force commanders (Figure 1-2).

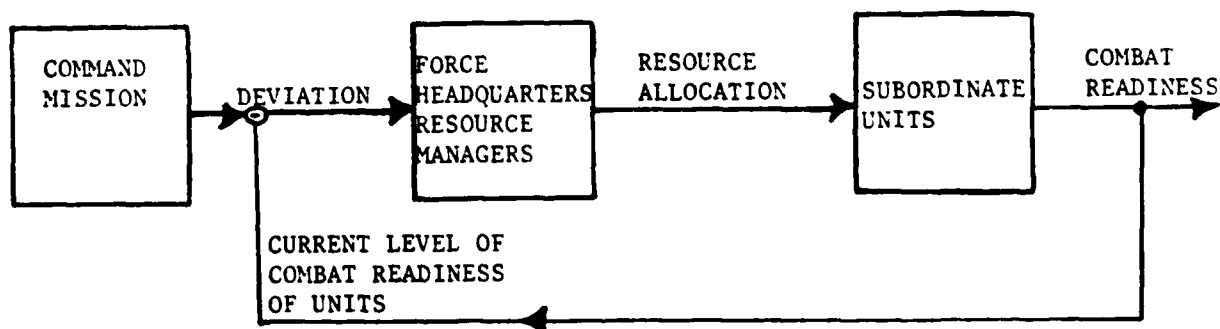


Figure 1-2

#### COMMAND MANAGEMENT OF COMBAT READINESS

This ideal framework simply reflects the principle that the combat readiness of a military unit is always the responsibility of the next superior command. At each command level, the commander influences the combat readiness of the subordinate units by managing and allocating the available resources, or by requesting the unavailable resources that

are necessary to correct any deviation in the required level of combat readiness consistent with the mission of the command.

The practical implementation of the ideal approach depicted in the above figures is difficult, however, because of the complex relationship between resource allocation and combat readiness. Unfortunately, it is also largely an ambiguous one, at present. There is no organizing framework within which DoD managers and military commanders can readily associate and compare the reported state of combat readiness with specified national security goals and command missions in order to determine discrepancies and initiate corrective action. As a result, DoD resources are too often allocated with little understanding of the impact the resources will have on the general state of combat readiness or, at the lower levels of command, on the combat readiness of specific military units.

Effective DoD resource management for combat readiness requires implementation of an organizational framework that integrates U.S. national security goals with the combat readiness of U.S. Armed Forces at the force, command, and unit levels, as illustrated in Figures 1-1 and 1-2. This is a difficult goal, and one that will take many years to complete. This final report describes efforts by DDI to develop a prototype resource management system for U.S. Marine Corps (USMC) combat units and represents a step toward achieving that difficult goal.

Resource management systems have two broad components: an evaluation system and an allocation system. In 1976-1977 the Defense Advanced Research Projects Agency (DARPA) agreed to fund an exploratory development effort that lead to a prototype evaluation methodology for the Marine Corps Combat Readiness Evaluation System (MCCRES). DARPA supported the

MCCRES development effort under the Advanced Decision Technology Program and arranged for the program's prime contractor, DDI, to work closely with Marine Corps personnel in developing a sound methodological approach. Combining the substantive expertise supplied by five Marine Corps officers assigned to the MCCRES project with proven decision analysis methodology, DDI constructed a prototype multi-attribute utility assessment (MAUA) model that permitted a rapid and systematic assessment of combat readiness. The model was successfully tested by the Marine Corps in August 1977, and MCCRES was adopted as the standard combat readiness assessment method for that Service. The implementing software for the assessment model, originally written by DDI for the IBM 5100 computer, was rewritten to permit implementation of the model on the IBM S/360 computer at Headquarters, USMC. MCCRES and its software model, MCCRESSA, MCCRES Software Application, are now in routine use throughout the Marine Corps with over 190 MCCRES evaluations having now been conducted.

DARPA has funded DDI's efforts to construct a prototype cost-benefit model and accompanying computer software for the Marine Corps Training Requirements and Cost Evaluation System (TRACES). The computerized system is called CTRACES, for Computerized Training Requirements and Cost Evaluation System. The cost-benefit model within CTRACES uses the combat readiness evaluation scores generated by the MAUA model within MCCRES and the costs of the various remedial training options as individually supplied by FMFLant and FMFPac to suggest optimal allocations of remedial training dollars at the battalion level. Thus, CTRACES is the allocation component of the resource management system for USMC combat units. The initial prototype version will be field-tested in Fall, 1980. This final report describes the conceptual framework, technical characteristics, and operational capabilities of the cost-benefit model and accompanying computer software for CTRACES.

## 2.0 TECHNICAL APPROACH

### 2.1 Conceptual Framework

The resource management system for USMC combat units has two major components: (1) an explicit evaluation model that specifies how well the combat unit is performing each of its primary tasks, and (2) an explicit training model that specifies the most beneficial remedial training activities for specific levels of cost. The components have been computerized so that they can provide immediate post-evaluation information about the areas of weak performance and, subsequently, the most cost-beneficial training activities. Furthermore, to ensure its utilization, the computerized system has been designed in a straightforward, user-oriented fashion and is not overly time-consuming to operate.

MCCRES is the evaluation component of the USMC system. MCCRES incorporates a multi-attribute utility assessment (MAUA) model that permits the systematic assessment of a USMC unit's combat readiness. In general, MAUA models are hierarchical in structure, starting with the specified top-level factor for which an overall evaluation score is desired. This factor is successively decomposed into subfactors in descending levels of the hierarchy such that each successive level is more specific than the one preceding. At the lowest level of the hierarchy are predictable or observable technical (or other) characteristics of the system under evaluation. These lowest level, highly specific characteristics are termed system elements.

Figure 2-1 presents a schematic of the MAUA model of MCCRES for USMC infantry units. The top-level factor is the overall combat readiness score. This factor is decomposed into separate categories of standards that specify the

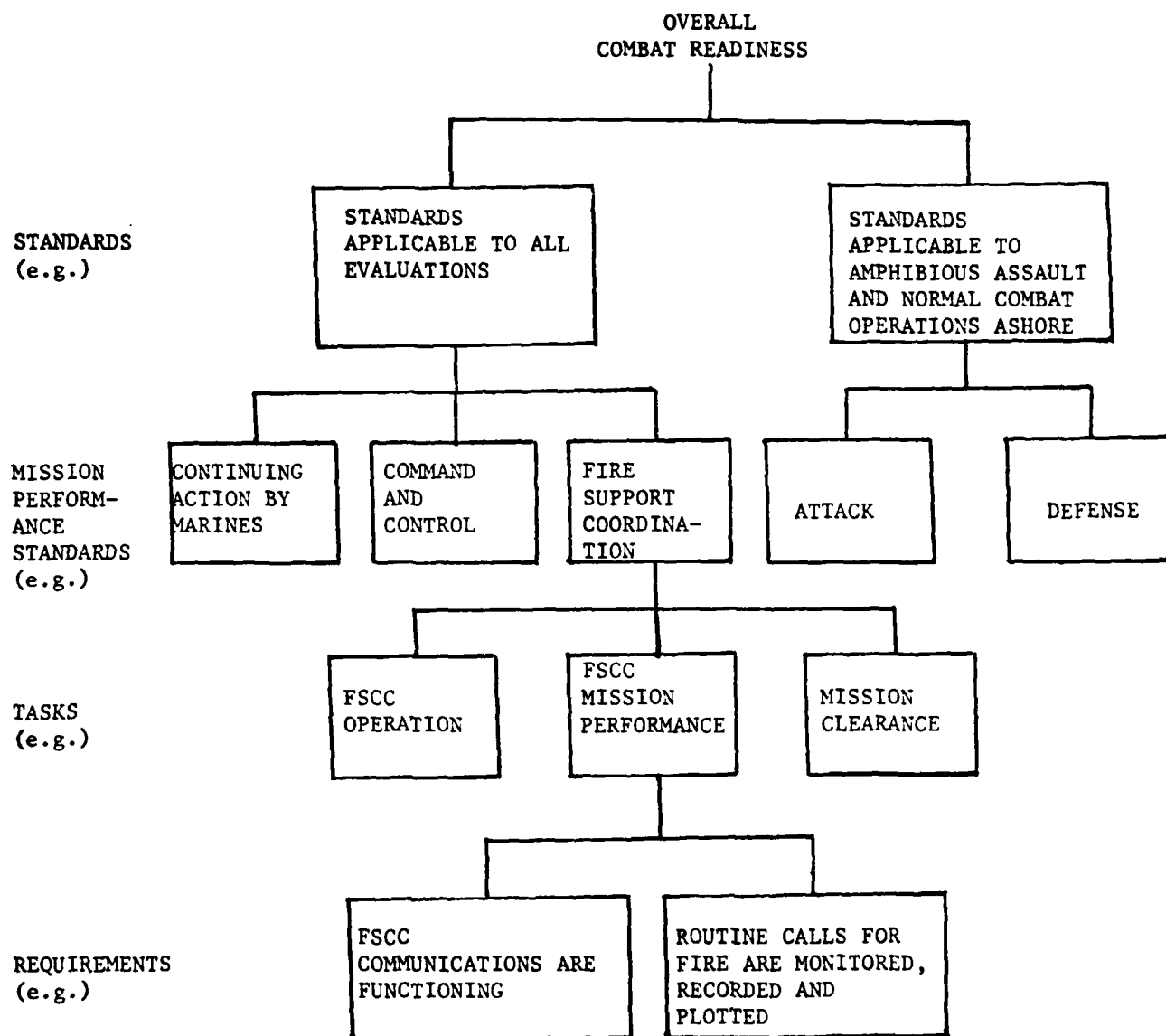


Figure 2-1

SCHEMATIC MAUA MODEL OF MCCRES FOR INFANTRY UNITS

appropriate mission performance standards (MPS) for the MCCRES evaluation. These standards are decomposed into specific tasks, which, in turn, are decomposed into the specific requirements that represent observable activities. Thus, different activities are integrated systematically to provide evaluation scores on individual performance areas and thereby yield an overall performance score.

The MAUA model is used, as follows, to provide an overall combat readiness score for an infantry unit. First, USMC evaluators rate whether the unit did or did not satisfy each of the requirements during the MCCRES evaluation. The unit's score on each task is computed by differentially weighting the ratings on the requirements comprising that task. Consequently, a unit that failed to satisfy important requirements on a task would get a low score on that task; if it failed certain demand requirements, it could get a score of zero on that task. In a similar fashion, the unit's score on each MPS is computed by differentially weighting the tasks comprising that MPS; a low score on an MPS implies that the unit did poorly on important tasks within that MPS. The MPS's are differentially weighted to provide a score on the standards which, in turn, are differentially weighted to provide an overall combat readiness score for the unit. The more combat ready the unit, the higher the overall score produced by the MAUA model. Poor overall performance can be readily attributed to poor performance on specific performance standards, tasks, and requirements.

TRACES is the training component of the USMC system; as mentioned earlier, the computerized system which has been developed by DDI is called CTRACES. CTRACES incorporates a general cost-benefit model that can be tailored to the needs of individual USMC battalions, as determined by their MCCRES evaluation. As a result, CTRACES is capable of telling

a battalion commander (1) in what areas the battalion performed weakly during its MCCRES evaluation; (2) the different training options (or activities) that can be exercised to improve performance on individual tasks within each MPS; (3) the projected benefit of each option for tasks within each MPS; (4) the projected cost of each training option; (5) the relative improvement in combat readiness that can be expected for specific expenditures of training funds; (6) the expected cost required to improve the battalion's combat readiness by a specific amount; and (7) better (more improvement for the same cost) and cheaper (less cost for the same improvement) alternatives to a specified training package. CTRACES has been designed to be an interactive system that permits battalion commanders to ask questions about these seven items in order to develop their actual package of remedial training activities.

Figure 2-2 represents a schematic of the benefit model within CTRACES. Again, the relation between overall benefit and different training options is hierarchical to ensure the explicit integration of the evaluation and training components of the overall system. The top-level factor is the overall benefit produced by any proposed package of training options. Overall benefit is decomposed into the benefits obtained for each MPS, which, in turn, is decomposed into the benefits obtained for each of the tasks comprising the MPS. The greatest overall benefit is obtained by training activities that effectively exercise important tasks within important performance areas on which the USMC unit performed weakly. The most cost-beneficial training activities are those that most effectively exercise those tasks for the level of money allocated for training.

It is important to point out that CTRACES cannot guarantee that the indicated number of points or percentage of deficit made up will actually be achieved in a second MCCRES

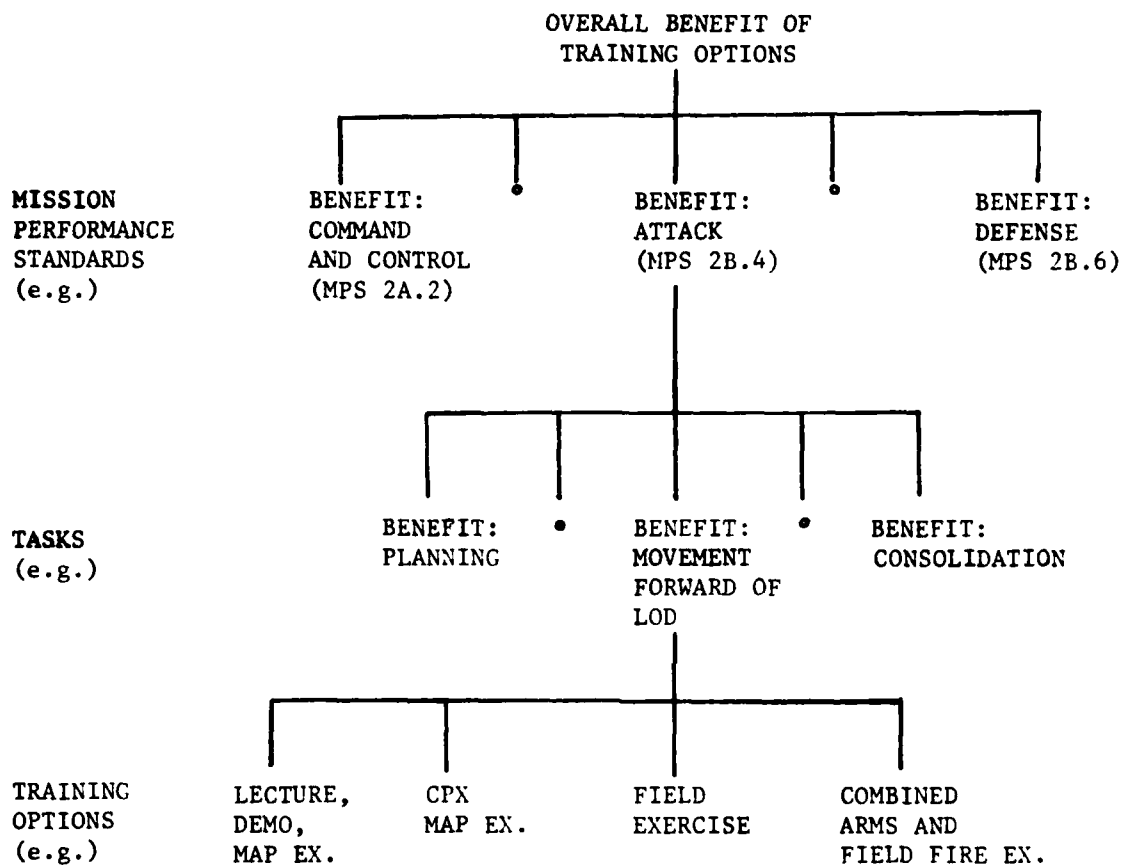


Figure 2-2

SCHEMATIC REPRESENTATION OF THE  
BENEFIT MODEL WITHIN CTRACES

evaluation. These values are expected values. They indicate that if an infantry battalion received a particular remedial training program immediately after its MCCRES evaluation and then participated in another MCCRES evaluation immediately after completing this program, then, on the average, the battalion would achieve these values on the exercised tasks. These values are estimates provided by USMC experts which are due to undergo field testing, and they cannot be guaranteed in every case. Similarly, CTRACES does not predict an overall MCCRES score because remedial training programs seldom provide training on tasks which the battalion performed well during its MCCRES evaluation. Consequently, one cannot be sure that the battalion will perform these tasks well again. Presumably, the shorter the time interval between MCCRES evaluations, the higher the probability of repeated good performance.

In sum, CTRACES has been designed to help battalion commanders develop a cost-effective strategy for remedial training. They will be able to identify how many points and what percentage of the MCCRES deficit their battalion can be expected to make up for the best package of remedial training options at a specific level of cost. In addition, battalion commanders will be able to evaluate the expected benefit and cost of particular training packages by using CTRACES' interactive capabilities. CTRACES' technical characteristics are discussed in the next section of the report.

## 2.2 Technical Characteristics

The technical characteristics of the TRACES/CTRACES system can be placed in three general categories: (1) Inputs to TRACES/CTRACES; (2) the cost-benefit algorithm used by TRACES/CTRACES; and (3) the outputs of TRACES/CTRACES. These items will be successively discussed in the

following three subsections. In discussing outputs, operation of the computer software will be briefly discussed as will interpretation of the outputs. (A more elaborate explanation appears in a User's Guide accompanying this report.)

2.2.1 Inputs to TRACES/CTRACES - The inputs to CTRACES are of three types: (1) information on MCCRES MPS's and tasks exercised and the scores received on them; (2) information on remedial training options including what they are, their length, which combinations are allowed, and what their costs are for FMFLant and FMFPac; and (3) the values of the remedial training options for the individual tasks including whether or not the option is applicable to the task, what percentage of the deficit would be made up if the option is applicable, and whether the option provides enhanced training on the task.

2.2.1.1 Information of MCCRES MPS's and Tasks - CTRACES must know exactly what MPS's and tasks were exercised during the relevant MCCRES evaluation and what scores were received on them. CTRACES is capable of retrieving this information directly from the MCCRES disk. There are seventeen possible MPS's which might have been chosen for a MCCRES evaluation. There are 107 possible tasks based on a decomposition of these seventeen MPS's; there are two to twelve tasks for each MPS. Three MPS's are always chosen for inclusion in any MCCRES evaluation; they are 2.A.1 (Continuing Action by Marines), 2.A.2 (Command and Control), and 2.A.3 (Fire Support Coordination). Three to five other MPS's are usually chosen, in addition to the required MPS's, to create the complete set of six to eight MPS's exercised in the typical MCCRES evaluation. All possible tasks under a given MPS need not be chosen, however, for a MCCRES evaluation. Consequently, CTRACES retrieves only the appropriate MPS's and tasks from the MCCRESSA computer disk and stores it in its own files.

#### 2.2.1.2 Information on remedial training options -

Ten major remedial training options and thirty-four lectures make up the total set of training options. The major options are as follows: A two-, three-, or four-day Command Post Exercise/Map Exercise (CPX); a two-, three-, or four-day Field Exercise (FX); a two-day Combined Arms Exercise (CAX); a two-day CPX combined with a two-day FX; a two-day CPX combined with a three-day FX; and a two-day CPX combined with a CAX. Each of the thirty-four possible lectures addresses a different combination of tasks. Any major option might potentially address all tasks requiring remedial training; the lectures cannot do so.

Four other major training options are treated in a special way by CTRACES because it was not possible to capture cost data for them. These are one- and two-day Combined Planning Exercises with the Navy (CPL) and one- and two-day Rehearsals (REH).

Table 2-1 provides the remedial training options and their costs as supplied by FMFLant. Similar data is being supplied by FMFPac. No cost data were requested from FMFLant or FMFPac for the CPL and REH options.

2.2.1.3 The values of the remedial training options - The first item of information to determine is whether or not a remedial training option can or cannot provide remedial training for the combat readiness weaknesses on a given task. Such information can be easily displayed using cross-matrices of tasks by options, one for each MPS. Figure 2-3 is such a cross matrix. A panel of experts composed of past and present Marine Corps Battalion Commanders and other Marine Corps experts knowledgeable in the use of MCCRES made the judgments displayed in this matrix. An X in a cell indicates that the option can provide remedial training. A major option made up of two other

CPX2	\$ 2374	
CPX3	3562	
CPX4	4748	
FX2	11476	
FX3	17214	
FX4	22952	
CAX	86411	(O&M, MC ONLY)
CPX2, FX2	13850	
CPX2, FX3	19588	
CPX2, CAX	88785	(O&M, MC ONLY)
CPL1	UNDETERMINED	
CPL2	UNDETERMINED	
REH1	UNDETERMINED	
REH2	UNDETERMINED	

LECTURES ARE PRICED AT \$500 EACH BASED ON EARLIER DATA; NO NEW DATA WAS SUPPLIED BY FMFLANT CONCERNING LECTURES.

Table 2-1

MAJOR OPTIONS AND THEIR COSTS (FMFLant)

## MISSION PERFORMANCE STANDARD 2B.4 ATTACK

TASKS	OPTION I LECTURE DEMONSTRATION MAP EX	OPTION II CPX MAP EX	OPTION III FIELD EX	OPTION IV COMBINED ARMS & FIELD FIRE EXERCISES
PLANNING	X	X		
PREPARATIONS	X	X		
PRELIMINARY OPERATIONS			X	X
MOVEMENT FORWARD OF LOD—PRIOR TO CROSSING FCL		X	X	X
CROSS FCL CONDUCT ASSAULT		X	X	X
CONSOLIDATION	X	X	X	X
EMPLOYMENT OF RESERVE		X	X	X
RESPONSE TO COUNTERATTACK		X	X	X
C.P. DISPLACEMENT		X	X	X

Figure 2-3

APPROPRIATENESS OF DIFFERENT TRAINING  
OPTIONS FOR DIFFERENT TASKS

major options can provide training if either of them can do so. Appendix A contains a complete set of matrices, one for each MPS. In each matrix, in the column for lectures, it has also been indicated which of the thirty-four possible lectures would provide remedial training for that task. Lectures provide remedial training on one to eight different tasks.

If a training option is applicable to a given task, CTRACES needs to know how much of the deficit occurring on that task can be made up via the option. This datum was elicited from the group of experts in the form of a Percentage of the Deficit Made Up (PDMU). PDMU varies as a function of the length of the training option and the score achieved on the MPS of which the relevant task is a member. PDMU is estimated as one number for all tasks belonging to a single MPS. The PDMU for major options that are combinations of others is calculated by a mathematical expression given in a subsequent section of this report. Figure 2-4 gives a set of PDMU estimates for MPS 2.B.4, Attack.

If the PDMU is estimated as 100% for those tasks in a chosen MPS, it is also possible for the option to provide enhanced training on the tasks. Enhanced training is training on an individual task that goes beyond remedial training, ensuring that activities performed properly during the relevant MCCRES evaluation will also be performed properly on the next evaluation. If enhanced training is possible, PDMU appears as 100<sup>+</sup>.

Appendix B presents a complete set of PDMU tables for all MPS's and their tasks. The following section provides details concerning the manipulation of the inputs to CTRACES which have been described in this section.

MCCRES	LECTURE
100-80	50
80-60	30
60-40	10
40	5

MCCRES SCORE ON MPS		CPX 2-Day	CPX 3-Day	CPX 4-Day
	100-80	65	80	85
	80-60	50	65	70
	60-40	20	30	45
	40	10	20	40

MCCRES SCORE ON		Field X 2 Days	Field X 3 Days	Field X 4 Days
	100-80	100	100+	100+
	80-60	85	95	100
	60-40	60	75	90
	40	30	60	75

MCCRES SCORE ON MPS		CAX 2 Days
	100-80	100+
	80-60	100
	60-40	80
	40	60

Figure 2-4

PERCENTAGE - DEFICIT - MADE-UP FOR  
MPS 2B.4: ATTACK

2.2.2 Data manipulation by CTRACES - Based on a MCCRES evaluation, a battalion receives (1) an overall score, (2) scores on the individual MPS's exercised, and (3) scores on those tasks exercised as part of each chosen MPS. The overall deficit, as well as the deficit on each relevant MPS and task, can be calculated by subtracting the score from 100. Since every relevant task that has been exercised is assigned a cumulative weight (CUMWT) in MCCRES, the sum of which is 100, the overall deficit is equal to the sum of the products of the task deficits and the task CUMWTs.

CTRACES assumes that the worth of performing the various training options (the PDMU's) can be more accurately judged at the MPS level of the MCCRES hierarchy than at the task level. However, in the TRACES model PDMU's must be applied at the task level because all options do not apply to all tasks, and different lectures apply to different tasks. (Requirements, the sub-nodes of tasks in MCCRES, do not play a role in CTRACES other than their being explicitly considered in making judgments of the worth of the training options as they apply to the tasks within an MPS.) USMC experts were asked to assess PDMUs at the task level during the initial stage of the project. These judgments turned out to be quite difficult and time consuming, increasing the number of assessments by a factor of approximately six, since there are about six tasks per MPS on the average. Furthermore, after an initial set of assessments, it was determined that PDMU variations are much more significant among tasks in different MPS's than among those within the same MPS. This is due to the fact that there is more similarity between tasks within the same MPS than between tasks in different MPSs, for tasks within the same MPS are more likely to be composed of a comparable number of activities. Consequently, PDMUs were assessed at the MPS level for the "typical" or "average" task within the MPS, and not for individual tasks of the MCCRES hierarchy.

If a training option is applicable to any task within a given MPS, the PDMU assigned to that task is the same for all tasks within that MPS. The PDMUs are invariant with the magnitude of the deficit on a given task. That is, for a given task, a certain training option is estimated to make up, for example, 50% of the deficit on that task, whether the score is 20 (and the deficit 80) or the score is 70 (and the deficit 30). Assuming that a given task will have a constant amount of time for remedial training no matter what the deficit on that task, the above rule for PDMU's implies that the greater the deficit, the greater the number of points that will be made up. That is, it's easier to buy points (provide training that will make up large numbers of points) when the deficit is large than when the deficit is small. Large deficits imply gross problems and coarser training activities. Small deficits imply minor problems and finer training activities likely to consume as much time as the coarser ones while buying few readiness points.

PDMU's were separately assessed for all training options within each MPS. In attempting to make these assessments, however, USMC participants indicated that the aggregate score on a given MPS also affected the ability of a training option to provide remedial training on the tasks within that MPS. This is true assuming that each MPS has been allotted a fixed amount of time for remedial training within a training option. As the score on a given MPS decreases, the number of tasks requiring remedial training that are part of that MPS will increase. Hence, the amount of time available for remedial training for each task will decrease and the PDMU for each task will decrease.

In summary, the expected benefit or value of a training option is represented by the percentage of the deficit it should make up (PDMU) on an MPS. The expected

benefit (or PDMU) of a training option for tasks within an MPS depends on (1) the battalion's MCCRES score on an MPS, (2) the overall effectiveness of the option for training on the MPS, and (3) the duration of the training option. This dependency is based on three assumptions. First, it was assumed that the better the battalion performed on an MPS, the more beneficial the option as a form of remedial training. Second, it was assumed that the more complete the training option, the greater the benefit; thus, it was assumed that a CPX provided more benefit than a lecture, that an FX provided more benefit than a CPX, and that a CA+FFX provided more benefit than an FX, in general. And third, it was assumed that the longer the training option, the greater the benefit. These three assumptions are illustrated in Figure 2-4, which shows the PDMUs for MPS 2B.4: Attack.

In TRACES, the benefit is measured as the number of points made up by a training option or combination of training options. The Points Made Up (PMU) on each individual task by a given training option (or combination of options) must be summed to yield the overall PMU for that option. The PMU on an individual task is the product of the PDMU for that task and the amount of the overall deficit that was contributed by that task. (The latter quantity is the product of the individual task's deficit [100 - Score] and its CUMWT.) To summarize, for a given training option,

$$PMU_{\text{overall}} = \sum_{i=1}^{107} [100 - \text{Score}_i] \times \text{CUMWT}_i \times \text{PDMU}_i,$$

where  $i$  indexes the tasks.

Major options are not always capable of providing remedial training for each task. Marine Corps experts did not make estimates of PDMU for the major options

that represent combinations of other options (e.g.,  $CPX_2 + FX_2$ ). Instead, a simple combination rule was used to derive these PDMU's. The rule was  $PDMU_{I,J} = PDMU_I + (1.0 - PDMU_I) \times PDMU_J$  or  $PDMU_{I,J} = 1 - (1 - PDMU_I) \times (1 - PDMU_J)$ , where the PDMU's are expressed as decimal fractions. Another characteristic of the TRACES model was that a lecture provides no remedial training value for a task if a major option is also being applied to that task. This implies that major options have a lecture component built into them.

As discussed in the previous section, another feature of TRACES is Enhanced Training. In certain instances, it is the case that a training option not only provides remedial training on those requirements of a task that were missed during a MCCRES evaluation, but also provides maintenance training on those requirements of a task that were not missed. Such training is termed Enhanced Training as it goes beyond the need for remediation on a task. TRACES is designed to tell the user how many and which tasks will be receiving Enhanced Training for a given option. It is possible to provide enhanced training on a task even if no remedial training was necessary (that is, even if the score on that task was 100).

Given the above details, TRACES simply calculates the PMU for any combination of a major option and lectures and also calculates the cost. The ratio of the two is then used as a measure of efficiency. There are numerous ways to manipulate these TRACES data to provide interesting and useful outputs for the battalion commanders. These are discussed in the following section.

**2.2.3 CTRACES outputs** - The purpose of this section is not to provide the CTRACES user with a complete understanding of the use of CTRACES but rather to give the reader an

understanding of the nature of CTRACES's outputs and how they should be interpreted and utilized. The outputs will be discussed in the three sections to follow as they relate to Potential Points Made Up (PPMU), Pareto Packages and Major Options, and Specified Training Packages.

2.2.3.1 Outputs concerning points to make up - Output concerning points to make up gives the battalion commander specific information concerning his strengths and weaknesses on the relevant MCCRES evaluation. Figure 2-5 presents a portion of the printout supplied concerning points to make up. This particular listing sorts (from greatest to least) MPS's based on the amount of the overall deficit they contribute. Tasks within an MPS are similarly sorted under each MPS. In the particular example presented here, the overall deficit is 45 points. MPS 2.A.1, for example, contributes 12.77 points or 28.19% of the overall deficit. The two right-most columns give the cumulative deficit (CUMDEF) and the cumulative percentage of the deficit (CUM%DEF) by MPS. Here it is the case that the three MPS's with the highest deficit contribute 26.75 points to the overall deficit which is 59.06% of that deficit.

CTRACES also provides two other outputs concerning points to make up. One presents MPS's and tasks in an unsorted fashion; the other presents only tasks sorted by deficit.

2.2.3.2 Outputs concerning Pareto Packages and Major Options - A Pareto (remedial training) Package is a combination of major options and tasks that provides the most Points Made Up (PMU) for a selected cost. Such a package lies on the Pareto frontier (belongs to the Pareto set) of all such packages spanning the entire range of possible costs. It is possible to plot in cost-benefit

SORTED BY MPS AND TASK

FACTOR		DEFICIT	%DEFICIT	CUMDEF	CUM%DEF
2.A.1	ACTNSBYMAR	12.77	28.19	12.77	28.19
2.A.1.3	COVER	3.05	6.73		
2.A.1.10	ENEMYAIR	1.75	3.87		
2.A.1.12	CASUALTIES	1.68	3.70		
2.A.1.6	RECONPATRL	1.10	2.62		
2.A.1.4	CAMOUFLAGE	1.17	2.58		
2.A.1.5	SECURITY	1.02	2.25		
2.A.1.2	DISPERSION	.98	2.11		
2.A.1.7	COMBATPTRL	.80	1.79		
2.A.1.11	POWS	.80	1.76		
2.A.1.8	ELECTRONIC	.26	.56		
2.B.1	SURFASSLT	7.58	16.70	20.35	44.93
2.B.1.3	SEIZESBJ	5.87	12.89		
2.B.1.4	BUILDUP	2.11	4.66		
2.B.1.1	DEBARRAIN	.00	.00		
2.A.3	FSUPTCOOPB	4.40	9.83	26.75	59.06
2.A.3.1	FSOCOPERB	1.25	2.77		
2.A.3.2	MISSIONPKO	1.27	2.69		
2.A.3.3	MISSIONCLR	1.12	2.63		
2.A.3.7	TARGETINTG	1.94	4.31		
2.A.3.8	COUNTREFIRE	.37	.82		
2.A.3.5	DEFERFIRE	.75	1.66		

Figure 2-5

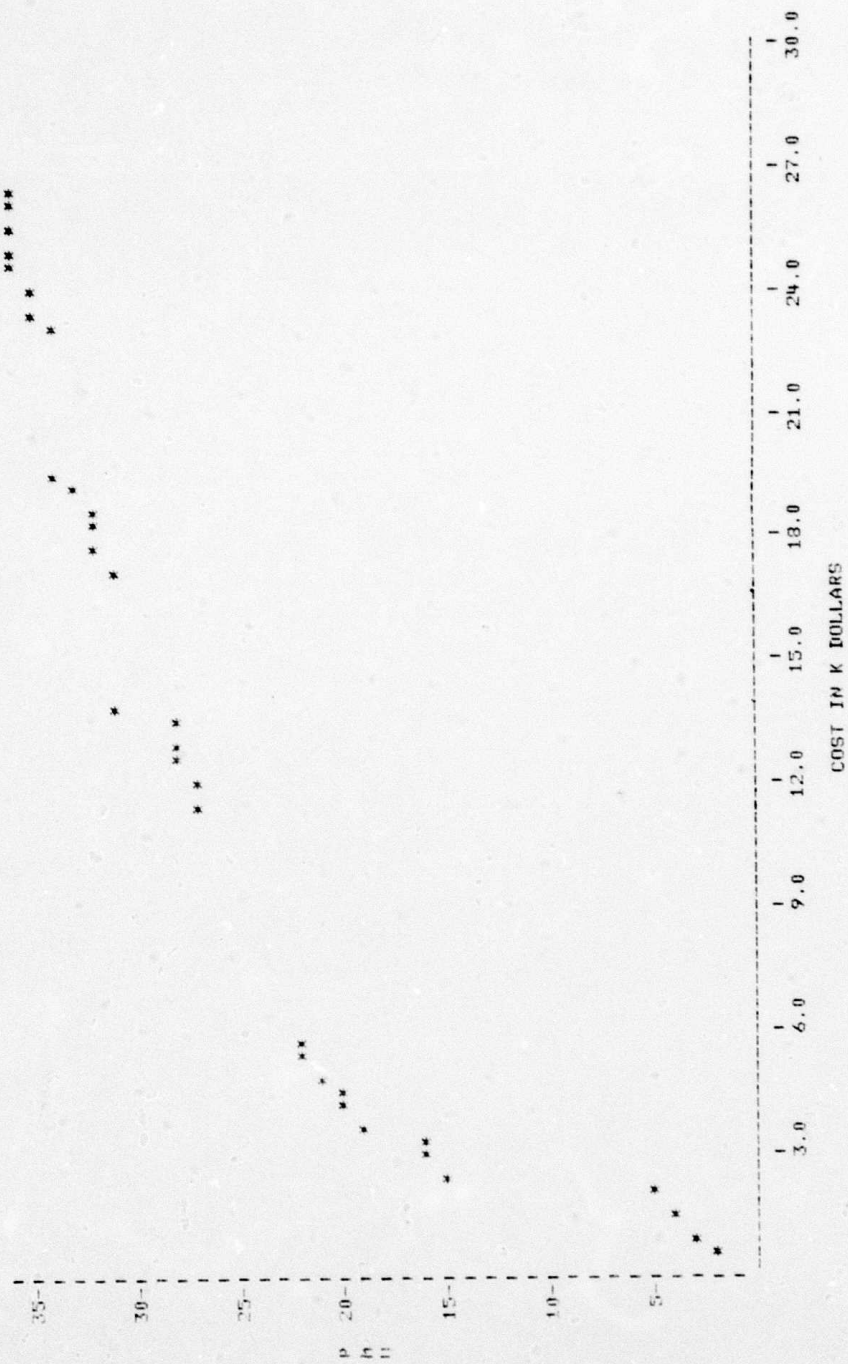
TRACES OUTPUTS CONCERNING DEFICITS SORTED  
BY MPS AND TASK

space both the entire set of Pareto points and those points corresponding to the major options and lectures (lectures alone and not in conjunction with major options). Figure 2-6 presents the plot of Pareto packages; a list of Pareto packages must be used in conjunction with this plot to determine which package corresponds to the point. The first nine items from such a listing appear in Figure 2-7. The listing indicates the composition of the relevant package, its cost, its PMU, and the number of tasks for which it provides enhanced training (#ENH). Figure 2-8 presents the cost-benefit plot for the major options and lectures. Figure 2-9 presents a list of cost, PMU, and #ENH for the lectures and major options. Notice that the lectures are treated as cumulative in cost and benefit and have been ranked in terms of decreasing benefit (the cost of \$500 is equivalent for each lecture).

#### 2.2.3.3 Outputs concerning Specified Packages -

CTRACES also provides outputs for three types of specified packages, those of a specified cost, those of a specified benefit, and those of a specified composition. The user can determine the best package (that providing the highest PMU) for a specified cost; the user can determine the cheapest package for a selected PMU; and the user can determine the cost and benefit of any package of a specified composition as well as alternatives to that package that are cheaper for the same level of benefit and better for the same level of cost. As Figure 2-10 shows, the user can optionally generate a plot of the cost-benefit space with the selected, cheaper, and better packages and the Pareto frontier. And as Figure 2-11 shows, the user can also optionally generate a listing of the points made up for each individual task by any specified package. This list provides the following items: the source of the points (lecture or major option), whether the task is receiving enhanced training, the PMU for the

# POINTS ON THE PARETO



NUMERIC INDICATES THE NUMBER OF POINTS IN ONE POSITION

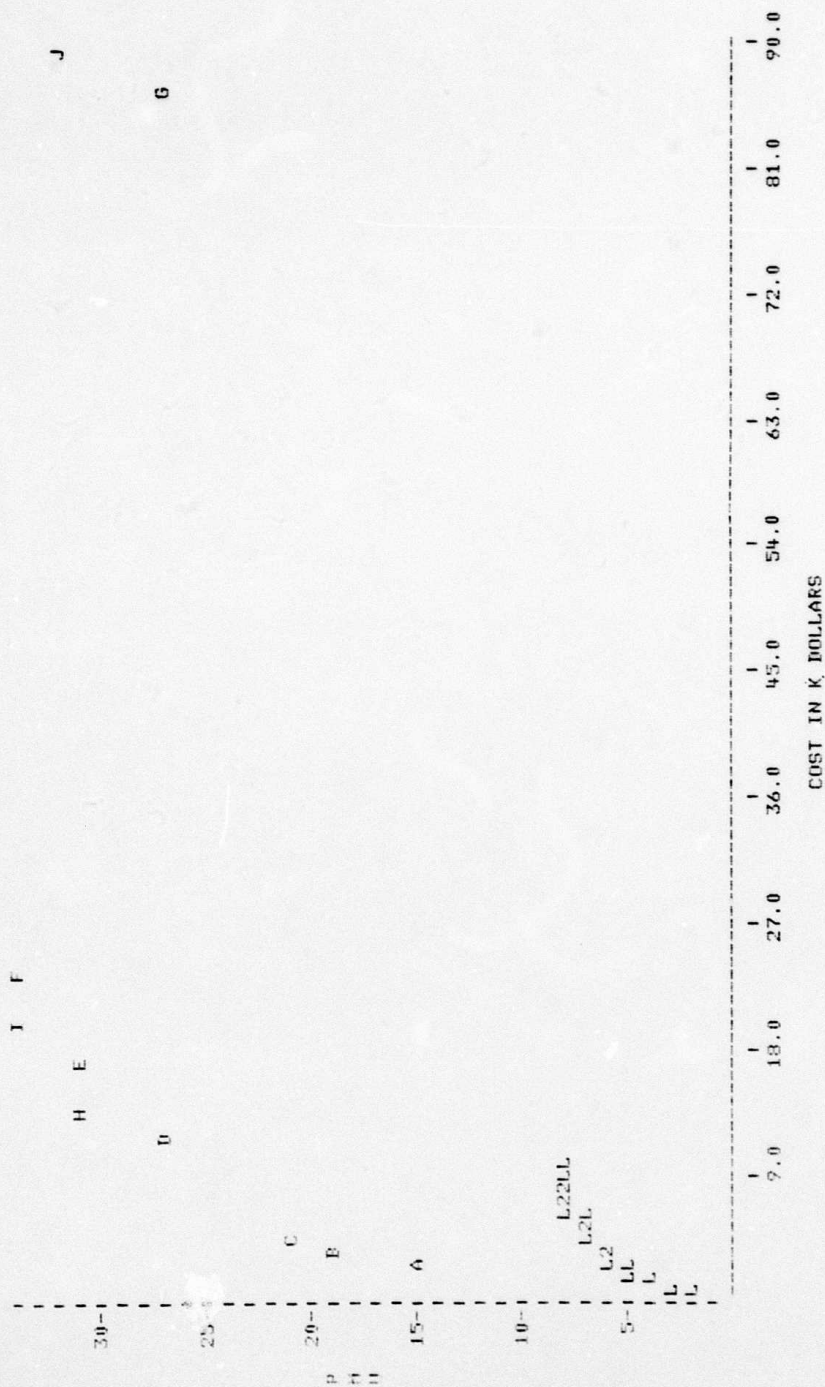
Figure 2-6  
POINTS ON THE PARETO  
PLOTTED BY PMU AND COST

# POINTS ON THE PARETO

	<u>COST</u>	<u>PMU</u>	<u>#ENH</u>
MAJOR OPTION: NONE LECTURES: L01	500	1.9633	0
	<u>COST</u>	<u>PMU</u>	<u>#ENH</u>
MAJOR OPTION: NONE LECTURES: L01 L02	1000	3.0030	0
	<u>COST</u>	<u>PMU</u>	<u>#ENH</u>
MAJOR OPTION: NONE LECTURES: L01 L02 L05	1500	3.8171	0
	<u>COST</u>	<u>PMU</u>	<u>#ENH</u>
MAJOR OPTION: NONE LECTURES: L01 L02 L05 L08	2000	4.5278	0
	<u>COST</u>	<u>PMU</u>	<u>#ENH</u>
MAJOR OPTION: CPX2	2374	14.8574	0
	<u>COST</u>	<u>PMU</u>	<u>#ENH</u>
MAJOR OPTION: CPX2 LECTURES: L01	2874	15.7152	0
	<u>COST</u>	<u>PMU</u>	<u>#ENH</u>
MAJOR OPTION: CPX2 LECTURES: L01 L11	3374	15.7505	0
	<u>COST</u>	<u>PMU</u>	<u>#ENH</u>
MAJOR OPTION: CPX3	3562	18.7071	0
	<u>COST</u>	<u>PMU</u>	<u>#ENH</u>
MAJOR OPTION: CPX3 LECTURES: L01	4062	19.5648	0

Figure 2-7

LISTING OF POINTS ON THE PARETO



A NUMERIC INDICATES THE NUMBER OF POINTS IN ONE POSITION

L = LECTURES  
 A = CPX2  
 B = CPX3  
 C = CPX4  
 D = FX2  
 E = FX3  
 F = FX4  
 G = CAX  
 H = CPX2,FX2  
 I = CPX2,FX3  
 J = CPX2,CAX

Figure 2-8  
 PLOT OF LECTURES AND MAJOR OPTIONS  
 GIVING COST, PMU, AND #ENH

# LIST OF LECTURES AND MAJOR OPTIONS

<u>OPTION</u>	<u>COST</u>	<u>PMU</u>	<u>#ENH</u>
L01	500	1.96	
+L02	1000	3.00	
+L05	1500	3.82	
+L08	2000	4.53	
+L27	2500	5.19	
+L07	3000	5.68	
+L26	3500	6.04	
+L03	4000	6.40	
+L29	4500	6.76	
+L30	5000	7.07	
+L04	5500	7.29	
+L16	6000	7.45	
+L31	6500	7.59	
+L34	7000	7.72	
+L12	7500	7.83	
+L09	8000	7.94	
+L15	8500	8.01	
+L11	9000	8.05	
+L13	9500	8.05	
A-CPX2	2374	14.86	0
B-CPX3	3562	18.71	0
C-CPX4	4750	21.27	5
D-FX2	11476	26.61	0
E-FX3	17214	30.83	7
F-FX4	22952	34.26	17
G-CAX	86411	26.95	7
H-CPX2,FX2	13850	30.78	0
I-CPX2,FX3	19588	34.03	7
J-CPX2,CAX	88785	32.48	7
CPL1		2.20	0
CPL2		2.44	0
REH1		1.31	0
REH2		1.96	0

Figure 2-9

LIST OF LECTURES AND MAJOR OPTIONS  
GIVING COST, PMU, AND #ENH

# PLOT OF SELECTED PACKAGE, CHEAPER PACKAGE, AND BETTER PACKAGE

S = SELECTED PACKAGE  
C = CHEAPER PACKAGE  
H = BETTER PACKAGE

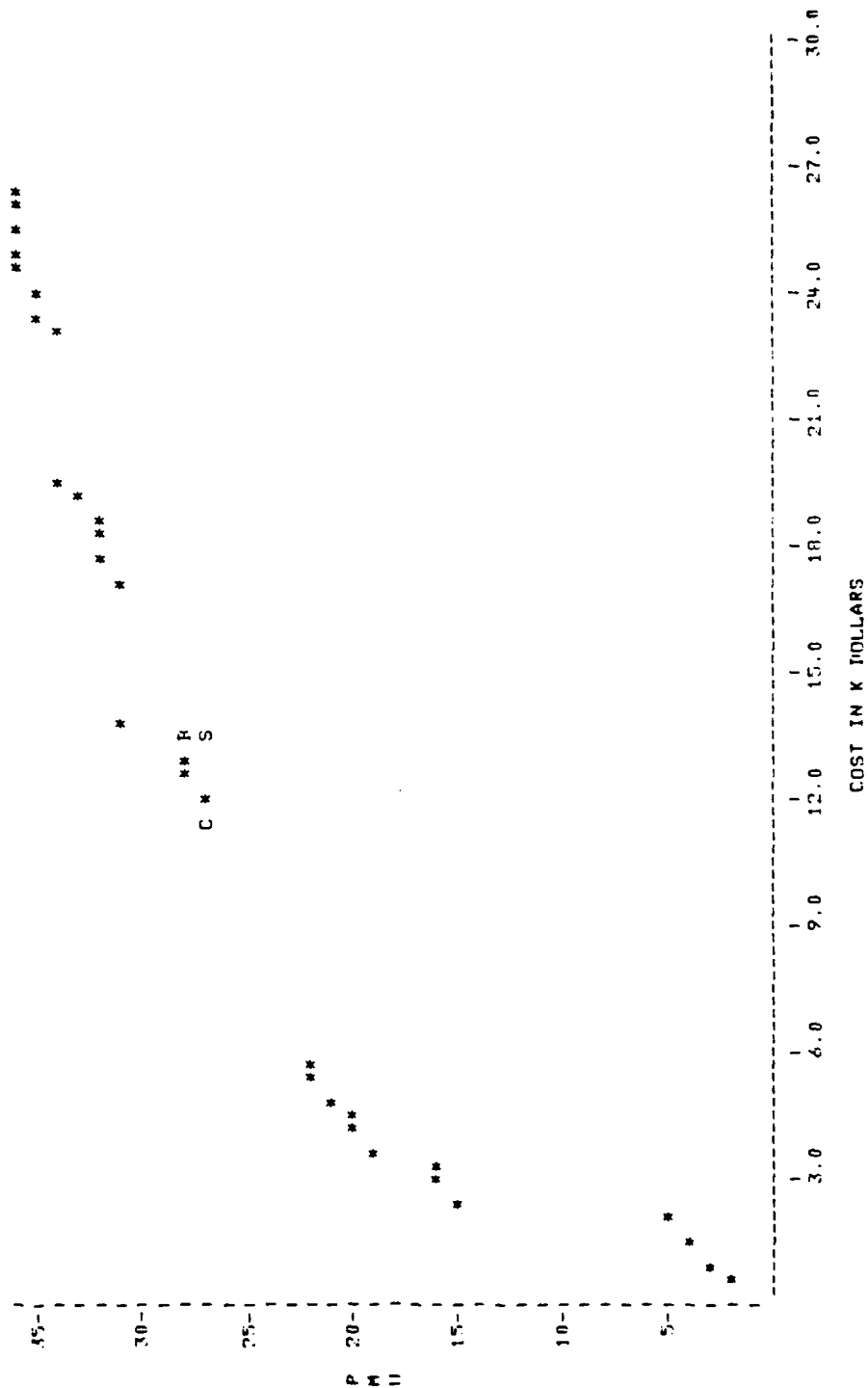


Figure 2-10

PLOT OF SELECTED PACKAGE, CHEAPER PACKAGE, AND BETTER PACKAGE

	<u>COST</u>	<u>PMU</u>	<u>#ENH</u>
MAJOR OPTION: CAX	87411	28.4827	7
LECTURES: L01 L08			

<u>FACTOR</u>		<u>SOURCE</u>	<u>ENH</u>	<u>PMU</u>	<u>%PMU</u>
2.A.1	ACTNSBYMAR				
2.A.1.2	DISPERSION	OPT	N	.9349	3.2824
2.A.1.3	COVER	OPT	N	2.8958	10.1668
2.A.1.4	CAMOUFLAGE	OPT	N	1.1107	3.8995
2.A.1.5	SECURITY	OPT	N	.9695	3.4037
2.A.1.6	RECONPATRL	OPT	N	1.1251	3.9501
2.A.1.7	COMBATPTRL	OPT	N	.8358	2.9344
2.A.1.8	ELECTRONIC	L01	N	.0767	.2692
2.A.1.10	ENEMYAIR	OPT	N	1.6657	5.8481
2.A.1.11	POWS	L01	N	.2386	.8375
2.A.1.12	CASUALTIES	L01	N	.5028	1.7654
2.A.2	CMD-CONTRD				
2.A.2.1	MANEUVER	OPT	N	.8375	2.9403
2.A.2.2	HIGHERHQ	OPT	N	.3401	1.1939
2.A.2.3	ORGANICFIR	OPT	N	.6687	2.3477
2.A.2.4	ATTACHFIRE		N	.0000	.0000
2.A.2.5	NGF	OPT	N	.4693	1.6475
2.A.2.7	LZCONTROL	OPT	N	.6814	2.3922
2.A.2.8	INTELL	OPT	N	.5715	2.0064
2.A.2.9	COMM	OPT	N	.7151	2.5107
2.A.2.10	LOG	OPT	N	.4260	1.4957
2.A.2.11	CASUALTIES		N	.0000	.0000
2.A.2.12	REPORTS		N	.0000	.0000
2.A.3	FSUPTCOORD				
2.A.3.1	FSCCOPERTN	OPT	N	1.1898	4.1772
2.A.3.2	MISSIONPRO	OPT	N	1.1563	4.0595
2.A.3.3	MISSIONCLR	OPT	N	1.1331	3.9783
2.A.3.5	DEFENFIRES	OPT	N	.7135	2.5649
2.A.3.6	COUNTRFIRE	OPT	N	.8466	2.9723
2.A.3.7	TARGETINFO	L08	N	.7107	2.4952

**Figure 2-11**  
**POINTS MADE UP FOR EACH TASK BY SPECIFIED PACKAGE**

task, and the percent PMU for the task (Percentage of the total possible PMU made up by that package currently being considered). It also provides the cost, PMU, and #ENH for the package.

### 3.0 SUMMARY

This final report has described the conceptual framework and technical characteristics for the prototype cost-benefit model and accompanying computer software (called CTRACES) which has been developed for the Marine Corps Training Requirements and Cost Evaluation System (TRACES). CTRACES is designed to help battalion commanders develop a cost-effective strategy for allocating remedial training funds. They will be able to identify how many points and what percentage of the MCCRES deficit their battalion can be expected to make up for the best package of remedial training options at a specific level of cost. In addition, battalion commanders will be able to evaluate the expected benefit and cost of particular training packages that they, or others, have proposed for consideration.

In general, CTRACES will provide battalion commanders with the following information: (1) those areas in which the battalion exhibited performance deficits in the course of its MCCRES evaluation; (2) the different training options (or activities) that can be exercised to improve performance on individual tasks within each Mission Performance Standard (MPS); (3) the projected remedial training benefit of each option for tasks within each MPS; (4) the projected cost of each training option; (5) the projected improvement in combat readiness that can be expected for specific expenditures of training funds; (6) the expected cost required to improve the battalion's combat readiness by a specific amount; and (7) better (more improvement for the same cost) and cheaper (less cost for the same improvement) alternatives to a specified training package.

The conceptual framework of the benefit model within CTRACES is a hierarchical, multi-attribute utility model.

The top-level factor is the overall benefit produced by any proposed package of training options. Overall benefit is decomposed into the benefits obtained for each MPS, which, in turn, is decomposed into the benefits obtained for each of the tasks comprising the MPS. The greater overall benefit is obtained by training activities that effectively exercise important tasks within important performance areas on which the USMC unit performed weakly. The most cost-beneficial training activities are those that most effectively exercise those tasks for the level of money allocated for training.

The technical characteristics of CTRACES that have been discussed include details on the following items: (1) inputs; (2) the cost-benefit algorithm; and (3) outputs. The key inputs to CTRACES involve information concerning MPS's and tasks, remedial training options, and the values of the remedial training options. The cost-benefit algorithm essentially aggregates across tasks the points made up by each training option and selects those options providing the most benefit per unit cost. Outputs of CTRACES deal with Potential Points Made Up, Pareto Packages and Major Options, and Specified Training Packages.

Through this effort, the USMC has been provided with a fully operational, prototype Training Requirements and Cost Evaluation System. In the months ahead, TRACES will undergo field testing and, no doubt, some subsequent modification. One important feature which might be added to CTRACES would be the ability for individual battalion commanders to challenge the PDMU estimates made by other USMC experts, and to witness the effects of these modifications on TRACES outputs. This is a form of "what if" sensitivity analysis. It is important, however, to rapidly proceed with field testing of the system "as is" in order that those at Headquarters, USMC can have the benefit of opinions from the user community and so

that the user community can rapidly begin receiving benefit from the newer component of their integrated resource management system, MCCRES/TRACES.

APPENDIX A

MATRICES INDICATING THE APPROPRIATENESS OF  
TRAINING OPTIONS FOR TASKS

MISSION PERFORMANCE STANDARD:						
2A.1			Continuing Actions by Marines			
	TASKS	OPTION I	OPTION II	OPTION III	OPTION IV	OPTION VI
		LECTURE	CPX	FIELD X	CAX	
1	2A.1.1 Discipline	X <sub>1</sub> *	X	X	X	
2	2A.1.2 Dispersion		X	X	X	
3	2A.1.3 Use of Cover			X	X	
4	2A.1.4 Use of Camouflage and Concealment			X	X	
5	2A.1.5 Security Action			X	X	
6	2A.1.6 Reconnaissance Patrolling	X <sub>1</sub>		X	X	
7	2A.1.7 Combat Patrolling	X <sub>1</sub>		X	X	
8	2A.1.8 Response to Enemy Electronic Warfare Capabilities	X <sub>1</sub>	X	X		
9	2A.1.9 Response to Enemy Chemical Warfare Capabilities	X <sub>1</sub>		X	X	
10	2A.1.10 Response to Enemy Air Capabilities	X <sub>1</sub>	X	X	X	
11	2A.1.11 Handling of Prisoners of War	X <sub>1</sub>		X		
12	2A.1.12 Casualty Handling	X <sub>1</sub>	X	X		

\*Indicates which of the 34 possible lectures is appropriate

MISSION PERFORMANCE STANDARD:						
		2A.2	Command and Control			
TASKS		OPTION I LECTURE	OPTION II CPX	OPTION III FIELD X	OPTION IV CAX	OPTION VI
1	2A.2.1 Maneuver Control	X <sub>2</sub>	X	X	X	
2	2A.2.2 Response to Direction from Higher Headquarters		X	X	X	
3	2A.2.3 Control of Organic Fire- power	X <sub>2</sub>	X	X	X	
4	2A.2.4 Control of Attached and Supporting Firepower Assets	X <sub>2</sub>	X	X	X	
5	2A.2.5 Control of Supporting Naval Gunfire	X <sub>2</sub>	X	X	X	
6	2A.2.6 Control of Air Delivered Firepower	X <sub>3</sub>	X	X	X	
7	2A.2.7 Landing Zone Control and Operation	X <sub>4</sub>	X	X	X	
8	2A.2.8 Coordination of Intelligence Effort		X	X	X	
9	2A.2.9 Communication Coordination		X	X	X	
10	2A.2.10 Coordination of Logistic Effort		X	X	X	
11	2A.2.11 Coordination of Casualty Treatment and Evacuation		X	X		
12	2A.2.12 Reports Control		X	X		

MISSION PERFORMANCE STANDARD:						
2A.3			Fire Support Coordination			
	TASKS	OPTION I	OPTION II	OPTION III	OPTION IV	OPTION V
		LECTURE	CPX	FIELD X	CAX	OPTION VI
1	2A.3.1 FSCC Operation	X <sub>5</sub>	X	X	X	
2	2A.3.2 FSCC Mission Processing		X	X	X	
3	2A.3.3 Mission Clearance		X	X	X	
4	2A.3.4 Offensive Fire Support	X <sub>6</sub>	X	X	X	
5	2A.3.5 Defensive Fire Support	X <sub>7</sub>	X	X	X	
6	2A.3.6 Counterfire Programs		X	X	X	
7	2A.3.7 Target Information Processing by FSCC	X <sub>8</sub>	X	X		
8						
9						
10						
11						
12						

MISSION PERFORMANCE STANDARD:						
			2B.1	Surface Assault		
TASKS	OPTION I	OPTION II	OPTION III	OPTION IV	OPTION V	OPTION VI
	LECTURE	CPX	FIELD X	CAX		
1 2B.1.1 Debarcation	X <sub>9</sub>	X	X			
2 2B.1.2 Assault Across the Beach		X	X	X		
3 2B.1.3 Seizure of Objectives			X	X		
4 2B.1.4 Buildup of Combat Power Ashore	X <sub>9</sub>	X	X	X		
5						
6						
7						
8						
9						
10						
11						
12						

MISSION PERFORMANCE STANDARD:						
			2B.2	Helicopterborne Assault		
TASKS	OPTION I LECTURE	OPTION II CPX	OPTION III FIELD X	OPTION IV CAX	OPTION V	OPTION VI
1 2B.2.1 Planning	X <sub>10</sub>	X	X	X		
2 2B.2.2 Preparation			X	X		
3 2B.2.3 Enplanement			X			
4 2B.2.4 Assault Into Landing Zone			X	X		
5 2B.2.5 Securing the Landing Zone			X	X		
6 2B.2.6 Seizure of Assigned Objective			X	X		
7 2B.2.7 Linkup		X	X	X		
8						
9						
10						
11						
12						

MISSION PERFORMANCE STANDARD:							
2.B.3				Movement to Contact			
TASKS		OPTION I	OPTION II	OPTION III	OPTION IV	OPTION V	OPTION VI
		LECTURE	CPX	FIELD X	CAX		
1	2B.3.1 Preparation		X	X	X		
2	2B.3.2 Route Column			X	X		
3	2B.3.3 Tactical Column			X	X		
4	2B.3.4 Approach March			X	X		
5	2B.3.5 Meeting Engagement	X <sub>11</sub>		X	X		
6							
7							
8							
9							
10							
11							
12							

MISSION PERFORMANCE STANDARD:						
2B.4			Attack			
TASKS		OPTION I	OPTION II	OPTION III	OPTION IV	OPTION V
		LECTURE	CPX	FIELD X	CAX	OPTION VI
1	2B.4.1 Planning	X <sub>12</sub>	X			
2	2B.4.2 Preparation	X <sub>12</sub>	X			
3	2B.4.3 Preliminary Operations			X	X	
4	2B.4.4 Maneuver Forward of LOD & Short of Final Coord. Line		X	X	X	
5	2B.4.5 Assault From Final Coordi- nation Line through the Obj		X	X	X	
6	2B.4.6 Consolidation	X <sub>13</sub>	X	X	X	
7	2B.4.7 Employment of the Reserve		X	X	X	
8	2B.4.8 Response to Counterattack		X	X	X	
9	2B.4.9 Command Post Displacement		X	X	X	
10						
11						
12						

MISSION PERFORMANCE STANDARD:						
			2B.5	Night Attack		
TASKS		OPTION I LECTURE	OPTION II CPX	OPTION III FIELD X	OPTION IV CAX	OPTION V
1	2B.5.1 Planning	X <sub>14</sub>	X			
2	2B.5.2 Preparation	X <sub>14</sub>		X		
3	2B.5.3 Maneuver to Line of Departure			X	X	
4	2B.5.4 Maneuver between the LOD & the Probable Line of Deploy-			X	X	
5	2B.5.5 Assault from PLD through Objective			X	X	
6	2B.5.6 Consolidation & Movement of the Reserve			X	X	
7	2B.5.7 Night Command Post Displacement		X	X	X	
8						
9						
10						
11						
12						

MISSION PERFORMANCE STANDARD:						
			2B.6	Defense		
TASKS		OPTION I LECTURE	OPTION II CPX	OPTION III FIELD X	OPTION IV CAX	OPTION V OPTION VI
1	2B.6.1 Planning	X <sub>15</sub>	X	X	X	
2	2B.6.2 Organization of the Ground			X	X	
3	2B.6.3 Actions Forward of the FEBA			X	X	
4	2B.6.4 Actions on the FEBA			X	X	
5	2B.6.5 Actions within the Position			X	X	
6	2B.6.6 Counterattack	X <sub>16</sub>	X	X	X	
7						
8						
9						
10						
11						
12						

MISSION PERFORMANCE STANDARD:						
			2B.7	Retrograde		
TASKS		OPTION I LECTURE	OPTION II CPX	OPTION III FIELD X	OPTION IV CAX	OPTION VI
1	2B.7.1 Planning	X <sub>17</sub>	X	X	X	
2	2B.7.2 Preparation			X	X	
3	2B.7.3 Delaying Action			X	X	
4	2B.7.4 Withdrawal Under Enemy Pressure			X		
5	2B.7.5 Withdrawal Without Enemy Pressure			X		
6	2B.7.6 Retirement			X		
7						
8						
9						
10						
11						
12						

MISSION PERFORMANCE STANDARD:						
2C.1			Tank Infantry Operations			
TASKS	OPTION I	OPTION II	OPTION III	OPTION IV	OPTION V	OPTION VI
	LECTURE	CPX	FIELD X	CAX		
1 2C.1.1 Planning	X <sub>18</sub>	X	X	X		
2 2C.1.2 Preparation			X	X		
3 2C.1.3 Tanks & Infantry on Same Axis			X	X		
4 2C.1.4 Tanks & Infantry on Converging Axis			X	X		
5 2C.1.5 Tanks Support by Fire Only			X	X		
6						
7						
8						
9						
10						
11						
12						

MISSION PERFORMANCE STANDARD:						
			2C.2	Mechanized Operations		
TASKS	OPTION I	OPTION II	OPTION III	OPTION IV	OPTION V	OPTION VI
	LECTURE	CPX	FIELD X	CAX		
1 2C.2.1 Planning	X <sub>19</sub>	X	X	X		
2 2C.2.2 Preparation		X	X	X		
3 2C.2.3 Mounted Maneuver			X	X		
4						
5						
6						
7						
8						
9						
10						
11						
12						

MISSION PERFORMANCE STANDARD:						
			2C.3	Military Operations in Built-Up Areas		
	TASKS	OPTION I	OPTION II	OPTION III	OPTION IV	OPTION V
		LECTURE	CPX	FIELD X	CAX	OPTION VI
1	2C.3.1 Planning	X <sub>20</sub>	X	X		
2	2C.3.2 Preparation		X	X	X	
3	2C.3.3 Isolation of the Built-Up Area			X	X	
4	2C.3.4 Seizure of an Initial Foothold in Built-Up Area			X	X	
5	2C.3.5 Advance Through Built-Up Area & Ejection of Enemy Force			X	X	
6	2C.3.6 Assumption of the Defense in a Built-Up Area	X <sub>21</sub>	X	X	X	
7						
8						
9						
10						
11						
12						

MISSION PERFORMANCE STANDARD:						
		2C.4	Evacuation Operations			
TASKS		OPTION I LECTURE	OPTION II CPX	OPTION III FIELD X	OPTION IV CAX	OPTION VI
1	2C.4.1 Planning and Preparation	X <sub>22</sub>	X	X		
2	2C.4.2 Initial Screening o. Evacuees	X <sub>23</sub>	X	X		
3	2C.4.3 Security Responsibilities for the Evacuation Control Center	X <sub>24</sub>	X	X		
4						
5						
6						
7						
8						
9						
10						
11						
12						

MISSION PERFORMANCE STANDARD:						
			2D.1	Amphibious Assault Planning		
TASKS	OPTION I	OPTION II	OPTION III	OPTION IV	OPTION V	OPTION VI
	LECTURE	CPX	FIELD X	CAX	CPL	REH
1 2D.1.1.1 Initial Planning Procedures	X <sub>25</sub>	X			X	
2 2D.1.2 Scheme of Maneuver	X <sub>26</sub>	X			X	
3 2D.1.3 Landing Plan	X <sub>26</sub>	X			X	
4 2D.1.4 Fire Support Planning	X <sub>27</sub>	X			X	
5 2D.1.5 Intelligence Planning	X <sub>28</sub>	X			X	
6 2D.1.6 Communications Planning	X <sub>29</sub>	X			X	
7 2D.1.7 Admin/Logistics Planning	X <sub>30</sub>	X			X	
8 2D.1.8 Embarkation Planning	X <sub>30</sub>	X			X	
9 2D.1.9 Rehearsal Plan	X <sub>31</sub>	X			X	
10						
11						
12						

MISSION PERFORMANCE STANDARD:						
			2D.2	Embarkation For Amphibious Assault		
TASKS	OPTION I	OPTION II	OPTION III	OPTION IV	OPTION V	OPTION VI
	LECTURE	CPX	REH			
1 2D.2.1 Preparation	X <sub>32</sub>	X	X			
2 2D.2.2 Control Measures at POE	X <sub>33</sub>	X	X			
3 2D.2.3 Movement to POE	X <sub>33</sub>	X	X			
4 2D.2.4 Loading		X	X			
5						
6						
7						
8						
9						
10						
11						
12						

MISSION PERFORMANCE STANDARD:		2D.3	Sea Transit and Rehearsal for Amphibious Assault			
TASKS	OPTION I	OPTION II	OPTION III	OPTION IV	OPTION V	OPTION VI
	LECTURE	REH				
1 2D.3.1 Sea Transit	X <sub>34</sub>	X				
2 2D.3.2 Rehearsal	X <sub>34</sub>	X				
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

APPENDIX B

PERCENTAGE OF DEFICIT MADE UP BY TRAINING OPTIONS  
AS A FUNCTION OF MPS SCORES

MPS: 2A.1 Continuing Action By Marines

MCCRES	LECTURE
100-80	50
80-60	30
60-40	10
40	10

		CPX 2-Day	CPX 3-Day	CPX 4-Day
MCCRES SCORE ON MPS	100-80	65	70	75
	80-60	40	60	65
	60-40	25	50	60
	40	10	30	40

		FIELD X 2-Day	FIELD X 3-Day	FIELD X 4-Day
MCCRES SCORE ON MPS	100-80	100	100+	100+
	80-60	90	100	100+
	60-40	60	80	90
	40	30	60	80

		CAX 2-Day
MCCRES SCORE ON MPS	100-80	100+
	80-60	95
	60-40	75
	40	30

MPS: 2A.2 Command And Control

MCCRES	LECTURE
100-80	80 All Three Bundles
80-60	50 All Three Bundles
60-40	30 All Three Bundles
40	10 All Three Bundles

		CPX 2-Day	CPX 3-Day	CPX 4-Day
MCCRES SCORE ON MPS	100-80	100	100+	100+
	80-60	80	90	100
	60-40	40	60	70
	40	30	45	60

		FIELD X 2-Day	FIELD X 3-Day	FIELD X 4-Day
MCCRES SCORE ON MPS	100-80	100	100+	100+
	80-60	85	90	100
	60-40	50	75	85
	40	20	40	60

		CAX 2-Day
MCCRES SCORE ON MPS	100-80	100
	80-60	95
	60-40	85
	40	50

MPS: 2A.3 Fire Support Coordination

MCCRES	LECTURE
100-80	85 All
80-60	65 All
60-40	30 All
40	10 All

		CPX 2-Day	CPX 3-Day	CPX 4-Day
MCCRES SCORE ON MPS	100-80	90	100	100+
	80-60	75	90	100
	60-40	60	75	80
	40	20	50	60

		FIELD X 2-Day	FIELD X 3-Day	FIELD X 4-Day
MCCRES SCORE ON MPS	100-80	100	100+	100+
	80-60	85	95	100
	60-40	50	65	80
	40	20	40	70

		CAX 2-Day
MCCRES SCORE ON MPS	100-80	100+
	80-60	95
	60-40	60
	40	30

MPS:2B.2 Helicopter Assault

MCCRES	LECTURE
100-80	65
80-60	20
60-40	10
40	5

		CPX 2-Day	CPX 3-Day	CPX 4-Day
MCCRES SCORE ON MPS	100-80	80	90	95
	80-60	60	75	80
	60-40	20	35	50
	40	10	20	25

		FIELD X 2-Day	FIELD X 3-Day	FIELD X 4-Day
MCCRES SCORE ON MPS	100-80	100	100+	100+
	80-60	85	95	100
	60-40	50	75	90
	40	20	50	70

		CAX 2-Day
MCCRES SCORE ON MPS	100-80	100+
	80-60	95
	60-40	60
	40	40

MPS: 2B.3 Movement to Contact

MCCRES	LECTURE
100-80	25
80-60	15
60-40	10
40	5

		CPX 2-Day	CPX 3-Day	CPX 4-Day
MCCRES SCORE ON MPS	100-80	75	85	100
	80-60	60	80	90
	60-40	30	45	60
	40	10	20	30

		FIELD X 2-Day	FIELD X 3-Day	FIELD X 4-Day
MCCRES SCORE ON MPS	100-80	85	100	100+
	80-60	70	90	100
	60-40	50	80	90
	40	20	40	70

		CAX 2-Day
MCCRES SCORE ON MPS	100-80	100
	80-60	90
	60-40	70
	40	40

MPS: 2B.4 Attack

MCCRES	LECTURE
100-80	50
80-60	30
60-40	10
40	5

		CPX 2-Day	CPX 3-Day	CPX 4-Day
MCCRES SCORE ON MPS	100-80	65	80	85
	80-60	50	65	70
	60-40	20	30	45
	40	10	20	40

		FIELD X 2-Day	FIELD X 3-Day	FIELD X 4-Day
MCCRES SCORE ON MPS	100-80	100	100+	100+
	80-60	85	95	100
	60-40	60	75	90
	40	30	60	75

		CAX 2-Day
MCCRES SCORE ON MPS	100-80	100+
	80-60	100
	60-40	80
	40	60

MPS: 2B.5 Night Attack

MCCRES	LECTURE
100-80	30
80-60	15
60-40	5
40	5

		CPX 2-Day	CPX 3-Day	CPX 4-Day
MCCRES SCORE ON MPS	100-80	50	70	75
	80-60	30	50	60
	60-40	10	30	40
	40	5	20	30

		FIELD X 2-Day	FIELD X 3-Day	FIELD X 4-Day
MCCRES SCORE ON MPS	100-80	95	100	100+
	80-60	75	85	100
	60-40	50	60	85
	40			

		CAX 2-Day
MCCRES SCORE ON MPS	100-80	100+
	80-60	90
	60-40	75
	40	50

MPS: 2B.6 Defense

MCCRES	LECTURE
100-80	65
80-60	50
60-40	30
40	20

		CPX 2-Day	CPX 3-Day	CPX 4-Day
MCCRES SCORE ON MPS	100-80	65	75	85
	80-60	50	65	75
	60-40	25	40	60
	40	10	40	50

		FIELD X 2-Day	FIELD X 3-Day	FIELD X 4-Day
MCCRES SCORE ON MPS	100-80	100	100+	100+
	80-60	90	100	100+
	60-40	65	85	100
	40	50	75	85

		CAX 2-Day
MCCRES SCORE ON MPS	100-80	100+
	80-60	100
	60-40	80
	40	65

MPS: 2B. 7 Retrograde

MCCRES	LECTURE
100-80	50
80-60	40
60-40	10
40	5

		CPX 2-Day	CPX 3-Day	CPX 4-Day
MCCRES SCORE ON MPS	100-80	65	75	80
	80-60	50	60	65
	60-40	20	40	50
	40	5	20	40

		FIELD X 2-Day	FIELD X 3-Day	FIELD X 4-Day
MCCRES SCORE ON MPS	100-80	100	100+	100+
	80-60	75	95	100
	60-40	65	80	90
	40	20	40	55

		CAX 2-Day
MCCRES SCORE ON MPS	100-80	100+
	80-60	100
	60-40	80
	40	40

MPS: 2C.1 Tank Infantry Operations

MCCRES	LECTURE
100-80	25
80-60	15
60-40	5
40	5

		CPX 2-Day	CPX 3-Day	CPX 4-Day
MCCRES SCORE ON MPS	100-80	50	60	75
	80-60	30	45	50
	60-40	10	20	40
	40	5	20	40

		FIELD X 2-Day	FIELD X 3-Day	FIELD X 4-Day
MCCRES SCORE ON MPS	100-80	100	100+	100+
	80-60	75	95	100
	60-40	65	85	95
	40	40	70	80

		CAX 2-Day
MCCRES SCORE ON MPS	100-80	100+
	80-60	100
	60-40	90
	40	85

MPS: 2C.2 Mechanized Operations

MCCRES	LECTURE
100-80	25
80-60	10
60-40	5
40	5

		CPX 2-Day	CPX 3-Day	CPX 4-Day
MCCRES SCORE ON MPS	100-80	50	60	80
	80-60	30	50	70
	60-40	10	40	65
	40	5	30	40

		FIELD X 2-Day	FIELD X 3-Day	FIELD X 4-Day
MCCRES SCORE ON MPS	100-80	95	100+	100+
	80-60	85	100	100+
	60-40	70	85	100
	40	50	75	90

		CAX 2-Day
MCCRES SCORE ON MPS	100-80	100+
	80-60	100
	60-40	95
	40	75

MPS: 2C.3 Military Operations in Built-Up Area

MCCRES	LECTURE
100-80	40
80-60	20
60-40	10
40	5

		CPX 2-Day	CPX 3-Day	CPX 4-Day
MCCRES SCORE ON MPS	100-80	50	65	70
	80-60	40	50	65
	60-40	10	20	30
	40	5	20	30

		FIELD X 2-Day	FIELD X 3-Day	FIELD X 4-Day
MCCRES SCORE ON MPS	100-80	95	100+	100+
	80-60	70	90	100+
	60-40	50	75	90
	40	50	65	80

		CAX 2-Day
MCCRES SCORE ON MPS	100-80	100+
	80-60	95
	60-40	75
	40	65

**MPS: 2C.4 Evacuation Operations**

MCCRES	LECTURE
100-80	70
80-60	60
60-40	20
40	5

		CPX 2-Day	CPX 3-Day	CPX 4-Day
MCCRES SCORE ON MPS	100-80	90	100	100+
	80-60	65	85	90
	60-40	40	70	80
	40	40	70	80

		FIELD X 2-Day	FIELD X 3-Day	FIELD X 4-Day
MCCRES SCORE ON MPS	100-80	100	100+	100+
	80-60	85	100	100+
	60-40	65	85	90
	40	50	75	90

		CAX 2-Day
MCCRES SCORE ON MPS	100-80	0
	80-60	0
	60-40	0
	40	0

**MPS: 2D.1 Amphibious Assault Planning**

MCCRES	LECTURE
100-80	90
80-60	80
60-40	75
40	50

		CPX 2-Day	CPX 3-Day	CPX 4-Day
MCCRES SCORE ON MPS	100-80	100	100+	100+
	80-60	95	100+	100+
	60-40	75	90	100+
	40	65	80	100

		FIELD X 2-Day	FIELD X 3-Day	FIELD X 4-Day
MCCRES SCORE ON MPS	100-80			
	80-60			
	60-40			
	40			

		CAX 2-Day
MCCRES SCORE ON MPS	100-80	
	80-60	
	60-40	
	40	

MPS: 2D.2 Embarkation for Amphibious Assault

MCCRES	LECTURE
100-80	85
80-60	60
60-40	30
40	10

		CPX 2-Day	CPX 3-Day	CPX 4-Day
MCCRES SCORE ON MPS	100-80	90	100	100+
	80-60	75	90	100+
	60-40	60	80	90
	40	30	70	80

		REHFARSAL 2-Day	REHFARSAL 3-Day	FIELD X 4-Day
MCCRES SCORE ON MPS	100-80	0	0	0
	80-60	0	0	0
	60-40	0	0	0
	40	0	0	0

		CAX 2-Day
MCCRES SCORE ON MPS	100-80	0
	80-60	0
	60-40	0
	40	0

MPS: 2D.3 Sea Transit & Rehearsal for Amphibious Assault

MCCRES	LECTURE
100-80	10
80-60	5
60-40	5
40	5

		CPX 2-Day	CPX 3-Day	CPX 4-Day
MCCRES SCORE ON MPS	100-80	40	45	50
	80-60	20	25	40
	60-40	10	20	35
	40	5	15	30

		REHEARSAL 2-Day	REHEARSAL 3-Day	FIELD X 4-Day
MCCRES SCORE ON MPS	100-80	0	0	0
	80-60	0	0	0
	60-40	0	0	0
	40	0	0	0

		CAX 2-Day
MCCRES SCORE ON MPS	100-80	0
	80-60	0
	60-40	0
	40	0